

# RadiaDroid – Simulated Radiation Detection in Smartphones

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**Abstract.** RadiaDroid is an Android application that simulates the portable radiation detector Intensimeter 28 civ. and uses virtual radioactive sources, defined by GPS coordinates, radionuclide and activity. The trainees load a scenario and search the exercise area for radioactivity. The locations of sources and safety perimeters are reported. Creation of scenarios is possible in the application, but is facilitated in a PC tool that also presents the reports and the dose to the trainee.

**KEYWORDS:** *smartphone, intensimeter, exercise, simulation, scenario, first responders*

## INTRODUCTION

New instruments can help to increase RN preparedness, but each organization has only a few instruments, making training limited. Exercises are important for the staff to feel comfortable with the new instrument and in their ability to interpret the readings. The Swedish Civil Contingencies Agency, the National Board of Health and Welfare, the Swedish National Police Board and the Swedish Radiation Protection Authority (SSM) recently provided Swedish fire brigades, hospital emergency units and police departments with the Intensimeter 28 civ, a slightly modified AN/UDR-13/UltraRadiac™-Plus (Canberra, 2007). Intensimeter 28 civ. is a rugged, portable radiation detector intended for first responders.

## THE SMARTPHONE APP

To carry out risk free exercises, a smartphone (Android) application<sup>1</sup> has been developed to simulate Intensimeter 28 civ. The application, called RadiaDroid, is available on Android Market<sup>2</sup>. RadiaDroid has a threefold purpose;

- (i) to train the handling of a specific instrument by simulating the functionality of the Intensimeter 28 civ. such as booting, selectable alarms, dose rate, cumulative dose and accuracy.
- (ii) to train searching for radioactive sources and to establish safety perimeters. In given or self-created scenarios, the trainee surveys an exercise area and tries to locate the virtually placed radioactive sources with the simulated instrument and establish the safety perimeters of the warm (contamination-reduction) zone and the hot (exclusion) zone, according to general instructions (MSB, 2010 and FEMA, 2003).
- (iii) to train the basic principles of radiation protection. The dose rate and accumulated dose are displayed in the instrument and saved to a log file giving the possibility to illustrate the Time, Distance and Shielding (TDS) principles of radiation protection.

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<sup>1</sup> Often abbreviated to “app”, short for application. Application in this case refers to a software application — in other words, a software program, typically intended for mobile devices, smartphones in particular.

<sup>2</sup> Freely available on Android Market: <https://market.android.com/details?id=com.RadiaDroid>

Training in RadiaDroid is divided into tutorials and scenarios. The first tutorial guides the trainee through the buttons of the instrument and their associated functions, each function is explained when the trainee touches the buttons. The second tutorial simulates a pre-set scenario, but gives text-based information on the distance to the source and how to interpret the readings. The tutorials are to be used as introduction and preparation for the scenario-based exercises.

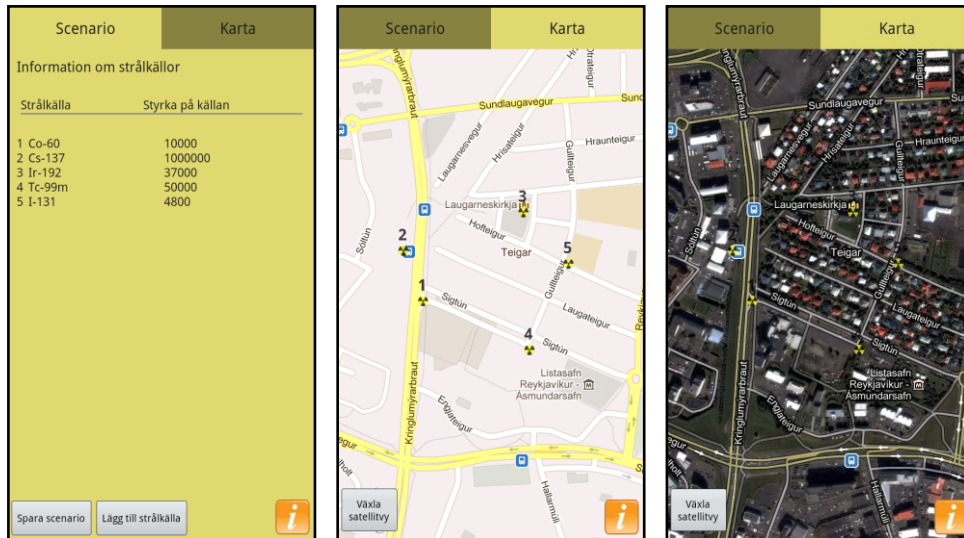


Figure 1. A scenario<sup>3</sup> is created in the application with 5 radioactive sources. The middle screen displays the source locations in central Reykjavik. The right hand screen is the same scenario presented over a hybrid satellite map.

In the scenarios, radiation is simulated by virtual radioactive sources, each defined by GPS coordinates, radionuclide and activity. Background radiation is simulated stochastically around a set mean. The scenarios can be created in the application (Figure 1) and distributed to other RadiaDroid trainees through Bluetooth, downloaded as a text file over Internet or directly from a PC.

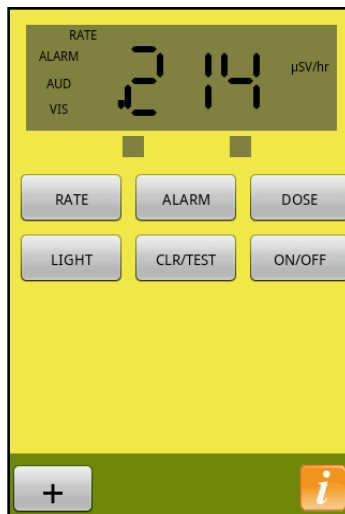


Figure 2. RadiaDroid main screen showing the dose rate in the simulated Intensimeter 28 civ.

<sup>3</sup> Download this scenario from [https://sites.google.com/site/radiaprojects/radiadroid/lce2\\_scenario.txt](https://sites.google.com/site/radiaprojects/radiadroid/lce2_scenario.txt), to be run in RadiaDroid.

After loading a scenario, RadiaDroid displays the calculated dose rate, given the radionuclides, their activities and locations, as stipulated in the scenario file. The screen is then only Intensimeter 28 civ. (Figure 2) with its functionality at hand.

The trainee must now survey the exercise area and try to find the sources and from the dose rate establish the perimeters of the safety zones and finally report the proposed locations of sources and their safety perimeters (Figure 3). Safety perimeters are supposed to be placed at  $10 \mu\text{Sv/h}$  for the warm zone and at  $100 \mu\text{Sv/h}$  for the hot zone. When the report is confirmed, the trainee is allowed to see the scenario (Figure 3). The report together with the search path and doses are saved to a log file to be read and displayed by the PC tool.

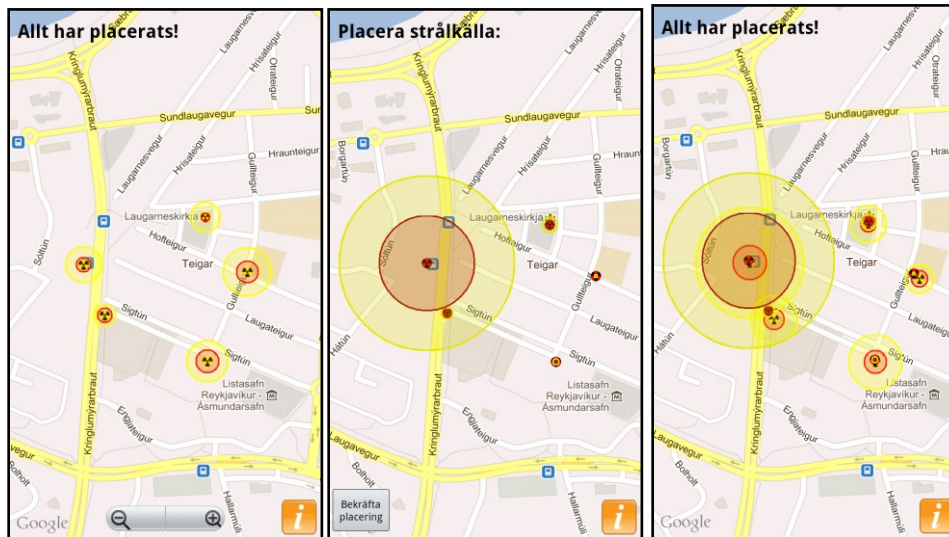


Figure 3. The scenario is reported in RadiaDroid (left screen) by source locations (yellow trefoils), hot zone perimeters (red circles) and warm zone perimeters (yellow circles). The true locations are displayed by red trefoils (middle screen). The report is compared with true answers (right screen). Here it is clear that some locations and perimeters deviate.

### THE PC LOG PRESENTATION TOOL

The PC tool has two purposes; one is to present the trainees reports, the other is to compose more complex scenarios.

The PC tool has been developed to facilitate the creation of scenarios with dispersed radioactivity (Figure 4, marker 2 in the map). The area of dispersed radioactivity is simulated by several point sources evenly distributed over the chosen area. Individual point sources (Figure 4, marker 1 in the map) can also be added to the scenario and their safety perimeters are calculated. In the RadiaDroid application, scenario creation is limited to point sources.

The scenario files are distributed to RadiaDroid trainees over Bluetooth connection, by downloading the files over internet or directly from a PC. A scenario file is a simple text file of only a few kilobytes (kB). They are freely readable, but may be hard to interpret without RadiaDroid or the PC tool.

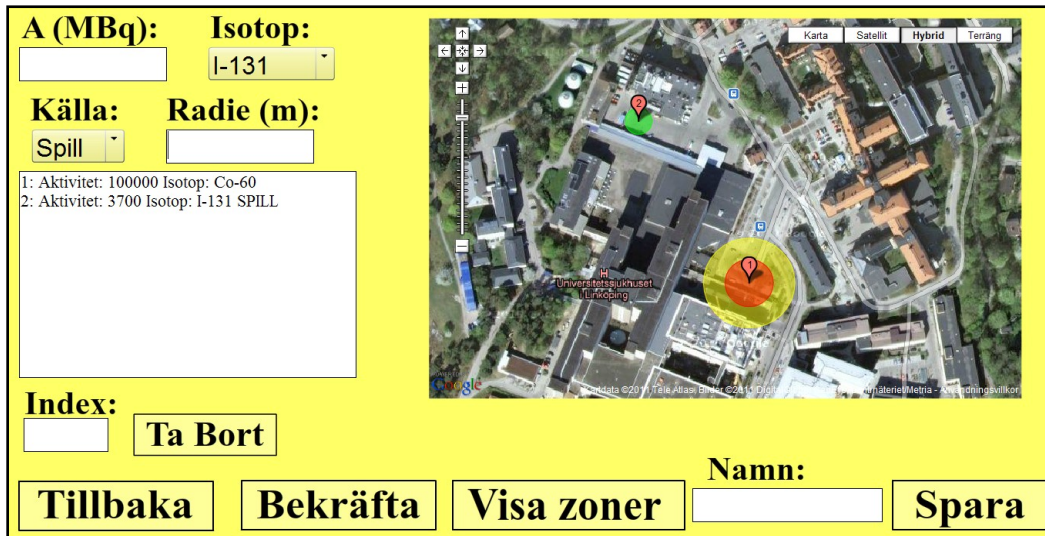


Figure 4. The PC tool facilitates the creation of dispersed radioactivity. Source 2 is dispersed over an area with a 10 m radius displayed as a green disc on the map. Source 1 is a point source with displayed safety zones. A scenario can be composed freely with dispersed sources and/or point sources.

The returned reports from the trainees are read and presented in the PC tool (Figure 5). Their search paths are replayed<sup>4</sup> individually (at 20x the actual speed), showing the dose rate and accumulated dose at each position. Proposed sources are displayed when and where the trainee suggested them, giving the instructor the possibility to analyze search strategies. All reports for each scenario can be displayed at the same time, as seen in Figure 5. Presentation of the correct locations and perimeters is optional (Figure 5, button “Facit” = answer). Overlapping safety zones are merged to one total safety zone. The tool is developed in Flash<sup>5</sup> (Adobe Sys. Inc.) and can be used in common web browsers supporting Flash. No installation is required.

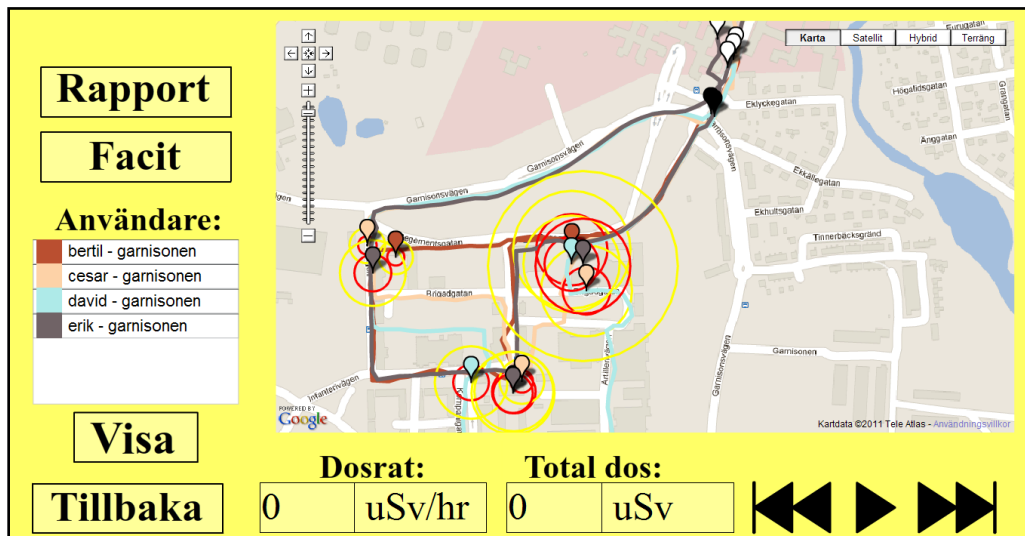


Figure 5. Four reports and logs are displayed simultaneously. The search paths and suggested source locations are colour-coded individually. White and black markers represent start and finish positions. Each search path can be replayed individually together with displayed dose rate and accumulated dose.

<sup>4</sup> To see a replay, please visit [www.youtube.com/watch?v=1aLhaNEdf1l](http://www.youtube.com/watch?v=1aLhaNEdf1l)

<sup>5</sup> <http://www.adobe.com/se/products/flashplayer/>

## **DISCUSSION**

The accuracy of the dose rate calculation in RadiaDroid is depending on the GPS accuracy. This can result in an off-set between the scenario and the report, if the trainee's reported (correct) position, displayed in RadiaDroid, could be a few meters off the placed source location in the scenario. The perception of the response and handling of the instrument is never the less the same. The scenarios can only be run when having a good GPS satellite connection, which limits the exercises to open air areas. No shielding is considered in the dose rate calculations, so exercises are considered as open field scenarios.

When setting the perimeters of the safety zones in reality, they are determined by, aside from the dose rate, wind conditions and established safety distances. That is not considered in the calculated perimeter locations, but can obviously be considered in the evaluation of the reports.

Intensimeter 28 civ. comes with a gamma/beta probe that is not simulated in RadiaDroid. The probe is mainly for contamination screening of people, which is hard to illustrate with the design of RadiaDroid.

In the future other instruments may be implemented. The application and PC tool are only implemented in Swedish so far and may be translated into other languages.

A project to evaluate the knowledge transfer to trainees using the application in training is pending.

## **ACKNOWLEDGEMENTS**

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